SAFE – Safe Food Advocacy Europe

# *Update on Micro and Nano plastic soil contamination and migration through the Food chain?*

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# SAFE

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## Who we are

SAFE is an independent non-profit organization that **represents interests of European consumers** all over Europe on issues connected to food safety and agriculture.

## Mission

**We** strives to **protect and advance consumers' rights** in **EU** food policy**.**

## Activities and goals

- Lobbying to improve the EU legislative framework
- Raising public awareness and training consumers
- Leading several EU projects on food safety and agriculture

# Micro and Nano plastics

**Microplastics** are small particles of plastic less than **5mm** in size;
**Nanoplastics** are even smaller, ranging from **1 to 100 nanometres** (N.B. 1 nanometre equals one-millionth of a millimetre).

In **2016, EFSA** identified the need to generate more data on their occurrence levels in food and on their potential effects on human health following exposure.

In the **25th EFSA Scientific Colloquium** on **2021**, the Italian Istituto Superiore della Sanità presented findings on the exposure of humans and animals to micro- and nano-plastics in food and feed.

In **June 2023**, SAFE Food Advocacy Europe presented to EFSA's Stakeholder Panel on Emerging Risks a paper on "*Concerns the risk of food contamination by BPA through its release from micro- and nano-plastics in soils and irrigation water*"

In **June 2024** SAFE Food Advocacy Europe presented to EFSA' Stakeholder Group on Emerging Risk a paper on "*Micro and nano plastics in agricultural soils could act as vectors of pollutants in the food chain?*"

# Micro and Nano plastics

## Micro and Nano plastics adsorption

**Micro and nanoplastics** due to their adsorptive capacity, are commonly used in *Fertilisers, Pesticides, Cosmetics, Paints and numerous other products.*

**Adsorption pathways** are mainly via **electrostatic attraction** and surface complexation and for **Physisorption** and **Chemisorption** mechanism.

In **2024** *Samuel J. Cusworth* and all published a significant paper how the **Agricultural fertilisers** contribute substantially to **microplastic concentrations** in **UK soils** *Communications Earth & Environment* **volume 5**, Article number: 7 (**2024**)

# Micro and Nano potential sources

## Contaminants in plastics contained in Compost and agricultural soil

# Micro and Nano potential sources

## Biodegradable plastics (BDPs)

The adverse effects of **organic plastic additives** on **soil biota** have been extensively documented.

The brominated flame retardants are among the highly hazardous plastic additives that have received the most attention in past. These chemicals have been found to be **carcinogenic, mutagenic, endocrine disrupting, or bio-accumulative**.

# Micro and Nano Plastic interaction

## Interaction between micro- and nano-plastics and potentially toxic elements (PTEs) in soil

**In 2019** *Verla, A.W.* et al discovered that **MPs serve as vectors** for both potentially toxic elements (PTEs) (i.e., Fe, Mn, Al, Pb, Cu, Ag, and Zn) and hydrophobic organic contaminants (i.e., persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), and polyaromatic hydrocarbons (PAHs) (*SN Appl. Sci.* ***2019***, *1, 1400 Microplastic–Toxic Chemical Interaction: A Review Study on Quantified Levels, Mechanism and Implication)*

In **2022**, *Avanthi Deshan* et all confirmed in a significant review the interactions between micro- and nano-plastics and soil pollutants In particular, Pb2+, Cd2+ and Cu2+. (*Microplastics* **2022**, *1*(1), 102-120; https://doi.org/10.3390/microplastics1010007).

# Micro and Nano Plastic interaction

## Possible pathway

In **2024** *Megha Bansa* published a review, proposing the **phytoremediation** as a possible way for addressing micro-nano-plastic contamination in soil and plants.

The phytoremediation is based on the synergistic effects of plants and the microorganisms that live in their rhizosphere.

Environmental Science and Pollution Research 2024 Feb;31(6):8354-8368. doi: 10.1007/s11356-023-31680-5.

# Micro and Nano Plastic interaction

## Possible pathway

In **2025** Nathaniel J. Clark et all. published a study showing that a vegetable can accumulate (or adsorb) **4.4 % of the nanoplastic** exposure via the root system, with a fraction **passing the Casparian strip** (1.5 % of the exposure).

They employed **a radiolabelling** approach to demonstrate, for the first time, that polystyrene nanoplastics (14C-PS NPs) accumulate and move into the edible tissues of radishes (Raphanus sativus).

These results highlight a potential pathway for human exposure to nanoplastics through the ingestion of edible plant parts, which requires further exploration, underscoring the need for further research into this emerging food safety issue .

Environmental Research 284 (2025) 122687.

# Micro and Nano Plastic interaction

## Possible pathway

The authors suggested that **future studies should extend** beyond a single polymer type and investigate uptake mechanisms across different nanoplastic sizes (e.g., >100 nm and <100 nm), potentially by using drugs to block pathways of uptake.

Experiments incorporating multiple concentrations, longer exposure durations, and time-course designs are needed to define **toxicokinetics** and assess **long-term accumulation**, particularly in edible tissues of commercial relevance.

In addition, examining **uptake across crop growth stages** and under more realistic conditions, including soil-based substrates with diverse physicochemical properties, **will be critical**.

•A 2025 study by Y demonstrated that the presence of **microplastics in soil** can **increase the accumulation of Cadmium (Cd)** in the **mature leaves of lettuce** (*Lact*

# Micro and Nano Plastic interaction

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## Possible pathway

Yimin Wang in **2023** suggested that the presence of **microplastics in soil** can **increase the accumulation of Cadmium (Cd)** in the **mature leaves of lettuce** (*Lactuca sativa*).

- A **hydroponic experiment** (soil-free conditions) was conducted to confirm the uptake pathway.
- Results showed that Cadmium preferentially **accumulated in the roots** initially.
- Subsequently, Cd was found to be **translocated to the mature leaves**.
- Crucially, **no Cadmium was detected in the young leaves**, suggesting a time-dependent transport and accumulation mechanism

Science of The Total Environment Volume 892, 20 September 2023, 164799

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# Micro and Nano Plastic interaction

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## Possible co-existence of MPs and antibiotics in soil ecosystems

Maoyuan Liao et al. (**2025**) conducted a review of the scientific literature on the potential risks associated with the co-existence of antibiotics and microplastics in soil.

- **Physicochemical Effects**
  MPs alter soil properties and reshape microbial community structure.
- **Selective Adsorption**
  MPs create localized hotspots of antibiotic accumulation in soil.
- **Ecological Niches**
  MPs promote microbial colonization and the formation of surface biofilms.

Current Opinion in Chemical Engineering Volume 50, December 2025, 101181

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# Micro and Nano Plastic interaction

## Possible co-existence of MPs and antibiotics in soil ecosystems

MPs not only alter soil structure and microbial communities but also act as vectors for ARB and ARGs, promoting their persistence and dissemination through soil–plant systems and into the food chain. This exacerbates the global antimicrobial resistance crisis while also threatening soil fertility, crop productivity, and ecosystem stability.

More studies are need.

Current Opinion in Chemical Engineering Volume 50, December 2025, 101181

# Conclusion

- New evidence has been published in the scientific literature regarding the potential contamination of the food chain through micro- and nanoplastics present in soil.

- However, many of the reviews we presented highlight divergences in extraction methods, analytical approaches, and sampling depth, which make these findings partial.

- Coordinated research led by the EU (for example, through Horizon 2020 projects) could help provide more certainty and generate data necessary for conducting risk assessments.

# Conclusion

- safe calls on **EFSA** to further investigate the high risk of contamination of the food chain via macro-meso-nano plastics.
- safe requests that the **policymaker** continue the positive environmental approach of the **Green Deal**, taking into account the introduction of new green agricultural techniques (mulching, composting, and new fertilizers and pesticides) in relation to the presence of **macro-, meso-, and nano-plastic** in soil, water, and air.
- safe calls on the Commission **to promote research projects** aimed at harmonizing sampling, analytical methods, and substrates, in order to provide data useful for a risk assessment of the impact of microplastic contamination in soils on the food chain

# Thank you for your attention!

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